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THE HAWAIIAN PLANTERS' MONTHLY

PUBLISHED FOR THE

HAWAIIAN SUGAR PLANTERS' ASSOCIATION

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SUGAR PRICES FOR MONTH ENDING DECEMBER 12, 1908.

		Centrifugals.	Beets.	Parity.
Nov.	14	3.92¢	10s 3d	4.16¢
"	16	3.92¢	10s 3d	4.16¢
"	17	3.92¢	10s 3d	4.16¢
"	18	3.92¢	10s 2¼d	4.15¢
"	19	3.92¢	10s 2¼d	4.15¢
"	20	3.92¢	10s 3d	4.16¢
"	21	3.92¢	10s 3¾d	4.18¢
"	23	3.92¢	10s 3d	4.16¢
"	24	3.92¢	10s 3d	4.16¢
"	25	3.92¢	10s 3¾d	4.18¢
"	26	3.92¢	10s 3¾d	4.18¢
"	27	3.92¢	10s 3d	4.16¢
"	28	3.92¢	10s 3d	4.16¢
"	30	3.92¢	10s 1½d	4.14¢
Dec.	1	3.92¢	10s 2¼d	4.15¢
"	2	3.92¢	10s 2¼d	4.15¢
"	3	3.92¢	10s 1½d	4.14¢
"	4	3.92¢	10s 2¼d	4.15¢
"	5	3.92¢	10s ¾d	4.12¢
"	8	3.86¢	10s	4.11¢

Messrs. Czarnikow, Macdougall & Co. under date of Nov. 20 report as follows:

Sugar Market.—Our last report was dated 13th November. During the past week the raw sugar market has been lifeless, and there has been neither pressure to sell nor to buy. The only ready foreign sugar available for buyers is the 17,000 tons Javas which are held in store by importers, and which are awaiting better market conditions before being put forward.

Some refining grades of domestic sugar of the Louisiana crop are likely to be sent to the Atlantic ports, and these will help to keep refiners going until Cuban sugars begin to come forward. In December of last year 25,800 tons Louisiana sugars were thus diverted, and there is no doubt that the same quantity, and probably more, can be spared by New Orleans this year. According to rumor, one of our independent refiners secured a quantity of Louisiana sugars at 3.6875c. If so, the landed cost of these sugars in New York would be 3.93c. to 3.95c., and they are therefore slightly cheaper than any other raws that can be obtained, either ex store here or for prompt shipment from nearby foreign producing countries.

No time can yet be named for the first shipments of new crop Cubas. Our private mail advices report that rains continue, that the canes are very green, and that any factories that start grinding in December are likely to have a poor yield. Apart from retarding the starting of the factories, the rains up to this time have been beneficial, especially to the spring plantings. Cable advices just received report a cessation of rains in some districts.

The first sale of new crop sugars to refiners was made this week at 2.50c. c.f., but as the quantity was only 1,400 tons, the transaction is not accepted as a basis for larger dealings in sugars for December-January shipment. Current quotations for early shipments are: December-January, 2.56c. c.f.; January-February, 2.50c. c.f.

The Ways and Means Committee of the House of Representatives, now engaged in framing new tariff proposals, gave two days' hearing this week to sugar interests. As was to be expected, very conflicting and diverse opinions were expressed. Louisiana's spokesman claimed that the greater part of the 20 per cent. preferential allowed to Cuba went to the United States refiners, and not to the Cuban producers who were intended to benefit by it, and that it should not be continued.

Domestic Beet interests advocated the maintenance of the existing duties, or if any change were made, that it should be an advance, as more protection was needed to make the industry successful. The proposal to allow sugars from the Philippines to come in free of duty was especially deprecated.

Secretary of War Wright claimed that the Domestic producer had nothing to fear from any additional concessions that might be granted to the Philippines.

Cuban-American interests made a strong argument in favor of lower sugar duties all round, but advocated the retention of the present preferential of 34 cents per 100 pounds to Cuba.

Independent refining interests in New York made a plea for free raw sugar, coupled with a moderate protective duty on refined.

The Chairman of the Committee intimated that the Philippine tariff might be taken up by itself and apart from the question of

general tariff revision. The Committee is expected to embody its proposals with regard to changes in the general tariff in a Bill which it will present to the House in March, 1909.

European Beet markets have been steady and slightly dearer. Today's f.o.b. quotations are: November, 10s. 3d.; December, 10s. 3d.; January-March, 10s. 5d.; May, 10s. 7d.; August, 10s. 9d.

Mr. F. O. Licht issued a new estimate today forecasting 4,715,000 tons for Convention countries and 6,490,000 tons for all Europe. This is a reduction of 65,000 tons on the former and of 50,000 tons on the latter, as compared with his estimate of 16th October.

The receipts for the week at the three Atlantic ports were 30,358 tons, made up as follows:

Cuba	1,611	Tons
Porto Rico	....	
Other W. I.	1,666	"
Brazil	1,071	"
Hawaiian Islands	8,754	"
Philippines	....	
Java	16,792	"
Other Foreign, 300; Domestic, 164	464	"

Willett & Gray in their Weekly Statistical of Nov. 25 state:

Raws.—The only special feature to mention in the week under review is the renewal of business in Louisiana domestic cane crop sugars by the Independent refiners.

The Arbuckle refinery are understood to have freight engagement for a minimum of 15,000 tons of these sugars on a basis equivalent to 3.92c. to 3.94c. per lb., 96° test, landed at refinery here.

The New Orleans market holds firm at basis of 3 11-16c., 96° test, with 1-32c. higher in instances.

Some renewal of interest is also shown by our refiners in early shipments of Cuba new crop Centrifugals at 2½c. c. & f., 96° test, equal to 3.86c. per lb. landed, but sellers are indifferent, and no business has recently been done.

European markets are without special change, the tendency being to slowly advancing prices on indications of decreasing crop estimates on account of loss of sugar content in the beets, as lastly cabled by F. O. Licht from Germany.

The weather continues favorable for the Cuba crop and an early maturity is expected.

Generally speaking, the sugar situation is favorable to the continuance of present values at home and abroad—for some time, at least.

NOTES.

DECREASING EMIGRATION.—Some interesting figures have been compiled showing the record of emigration and immigration for the first nine months of 1908. Since the depression of the latter part of 1907 the departure of steerage passengers from the United States has very largely exceeded the arrivals, but the month of September brought a definite halt to the exodus of the country's foreign labor population. Steamship figures given out with the close of the month show that there was a decline in emigration compared with July of 23,500—no less than 37 per cent.—and that for the first time since the October panic, the outward steerage movement actually fell short of a twelve month before.

The sudden slackening in departures very likely signifies that the drain on the country's labor force has about ended. But whether it signifies that re-employment has begun or is about to begin is another matter. The phenomenal exodus of the unemployed is over, but, on the other hand, there has come no corresponding increase in immigration, September's arrivals actually falling short of August, and September's departures still exceeding arrivals. Either the foreigner who left last spring anticipates no immediate industrial revival here, or is satisfied to await the revival before coming back.

Here is the monthly record of the year thus far, both of steerage arrivals and departures compared with 1907:

EMIGRATION.

	1908.	1907.	Change.
January	58,767	16,272	+ 42,495
February	50,394	16,119	+ 34,265
March	46,311	20,092	+ 26,219
April	87,561	27,944	+ 59,617
May	75,345	33,710	+ 41,635
June	59,296	41,655	+ 17,641
July	64,468	52,426	+ 12,042
August	63,642	50,050	+ 13,592
September	40,188	43,028	— 2,840
Total 9 months	545,962	301,296	+244,666

IMMIGRATION.

	1908.	1907.	Change.
January	27,220	54,417	— 27,197
February	23,381	65,541	— 42,100
March	32,517	139,118	—106,601
April	41,274	145,256	—103,982
May	36,317	183,526	—147,209

	1908.	1907.	Change.
June	20,073	136,843	—116,770
July	29,518	134,501	—104,983
August	41,938	121,087	— 79,149
September	38,502	101,862	— 63,365
Total 9 months	290,740	1,082,156	—791,416
Excess emigration	255,222		
Decrease in immigration			780,860

CROP OF 1908-1909.—By the end of December harvesting of this crop will be in full swing on a large number of the plantations. It is too early to estimate with any degree of accuracy the outturn of the crop; in many localities the cane has been very much in need of more water for some months past and there will be some loss on this account. The winter rains have now probably commenced and if a very wet winter follows a low purity of juice will very likely be the result. The weather conditions of the coming four or five months will have very much to do with the crop. The area under cultivation for this crop is approximately the same as for last year and an outturn of say 490,000 tons may probably be expected.

FORESTRY IN HAWAII.

The fourth report of the Board of Commissioners of Agriculture and Forestry of the Territory of Hawaii, for the year ending December 31, 1907, has just been issued. The report embraces the general report of the Commissioners, reports of the divisions of forestry, entomology and animal industry, and contains much that is of general interest to the agricultural industries of the country. The article on insect investigations in Mexico by A. Koebele, relates almost entirely to insects affecting sugar cane and being of particular interest to the sugar planters is published in full in this issue.

The report of R. S. Hosmer, superintendent of forestry, while containing some matter which is, at this date, rather stale, is still very interesting.

On the part of the Territory itself the points of notable interest during 1907 in the history of forestry in Hawaii are a definite annunciation of policy in regard to the two main classes of Hawaiian forest. the extension of the forest reserve system, through the setting apart of additional areas and the completion of field work bearing directly on the creation of other new reserves; the establishment of a systematic exchange of seed with Botanic Gardens and other similar institutions; and an amendment to the forest law giving to the Governor more extended power in the creation of forest reserves.

On the part of private interests and corporations there is also much that is worthy of record. Particularly to be noted is the increasing interest in tree planting on waste lands; the extension of the rubber plantations on Maui; the beginning of a coconut industry; and especially the real establishment of the lumber industry in the leeward districts on Hawaii through the signing of a contract between the Hawaiian Mahogany Lumber Company and the Santa Fe Railway System whereby there will be sent to the mainland during the next five years over 2,500,000 Ohia Lehua railroad ties.

Forest Reserves.—Since the organization of the Division of Forestry the creation of forest reserves has rightly been held to be the forest work of first importance. The successful development of agriculture in Hawaii, especially in the districts where irrigation is necessary, is so closely bound up with the welfare of the forest that it is of paramount importance that the forest cover on the water sheds be carefully and wisely managed. It cannot too often be said that the chief value of by far the greater part of the Hawaiian forest does now and always must rest in the influence that the forest exerts on the conservation of water. For the maintenance of a permanent, dependable supply the forest is essential.

The methods that are followed in the creation of forest reserves in Hawaii, with other information in regard to the reserves established, have been covered fully in former reports. It may, however, not be out of place here to state again that the prime object in the creation of all but one of the thirteen forest reserves that have so far been established is to protect the forest on the water sheds of the important streams. These forest reserves are essentially "protection forests." Their most valuable product is water. By safeguarding the sources of the supply they render direct economic return to the Territory.

Mr. Hosmer calls attention to the two main classes of Hawaiian forests, that is, the water bearing protection forest, essentially of value because of the water it can produce; and the non-water-bearing commercial forest, the main value of which rests in the wood and timber that it yields.

In the water-bearing forest the most important product is *water*, and consequently the forest ought to be so managed as to yield permanently the largest possible dependable supply. With the short water sheds, the steep slopes and the susceptibility of the Hawaiian forest to injury, to secure the best results in most of the water-bearing forests it is essential that the forest cover be kept strictly intact—that the forest be maintained exclusively as a protection forest.

In the leeward districts on Hawaii a different condition prevails. Here there are no permanent streams and but few springs. Consequently the forest is not needed for water shed protection, but is to be reckoned chiefly of value because it can be made to

yield wood and timber. Much of the land in Kona, Puna and Kau can be used to better advantage for growing trees than for any other purpose. Obviously the wise use of this type of forest is so to manage it that it shall yield repeated crops of valuable timber. The object in both cases is to put the forest to wise use; to make it serve the purpose for which it is best adapted. In the one case its most valuable product is water; in the other it is wood.

The report deals with a number of interesting topics. The fungus disease of forests on Maui, which is causing considerable worry, the lumber industry of the island of Hawaii, forest extension and an account of what is being done in tree planting, the needs in forest work all being set out clearly and forcibly.

A HISTORY OF THE PROGRESS OF THE SUGAR INDUSTRY OF HAWAII SINCE THE RECIPROCITY TREATY OF 1876.

So many extraneous causes have stimulated, or at times depressed, the sugar industry of the Islands, and so many elements have entered into the increase of production itself, that it is somewhat of a problem, after getting in hand all available information, to write a connected account of the progress of the industry.

We will first trace the general development of the industry along the lines of production and acreage, and will then take up the various causes leading to the increase of production and stimulating the industry, with a brief and general account of the progress made in its various branches, with such comments as seem to be of value.

INCREASE IN ACREAGE AND PRODUCTION.

Previous to 1882 there was no organization of the sugar planters of the Islands, and there is very little available in the nature of statistics relating to the industry during the years between that time and the establishment of the first sugar plantation on a commercial basis.

Although this report does not undertake to go farther back than the date of the granting of the reciprocity treaty by the United States, as a matter of general interest there is shown in the following table the exports of sugar and molasses from the Hawaiian Islands from 1837 to 1876:

YEARLY EXPORTS OF SUGAR AND MOLASSES FROM THE HAWAIIAN ISLANDS SINCE 1867—ITS FIRST YEAR OF EXPORTATION.

Year	Sugar Pounds	Molasses Gallons
1837	4,286	2,700
1838	88,543	11,500
1839	100,000	75,000
1840*	360,000	31,729
1841**	60,000	6,000
1842***	.....	.....
1843	1,145,010	64,320
1844	513,684	27,026
1845	302,114	19,353
1846	300,000	16,000
1847	594,816	17,928
1848	499,533	28,978
1849	653,820	41,235
1850	750,238	129,432
1851	21,030	43,742
1852	699,170	62,030
1853	642,746	75,769
1854	575,777	68,372
1855	289,908	38,304
1856	554,805	58,842
1857	700,556	48,486
1858	1,204,061	75,181
1859	1,826,620	87,513
1860	1,444,271	108,613
1861	2,562,498	128,259
1862	3,005,603	130,445
1863	5,292,121	114,413
1864	10,414,441	340,436
1865	15,318,097	542,819
1866	17,729,161	851,795
1867	17,127,187	544,994
1868	18,312,926	492,839
1869	18,302,110	338,311
1870	18,783,639	216,662
1871	21,760,773	271,291
1872	16,995,402	192,105
1873	23,129,101	146,459
1874	24,566,611	90,060
1875	25,080,182	93,722
1876	26,072,429	139,073

(*) These figures are from January to August only, while for 1841 (**) the figures are from August, 1840, to August, 1841. (***) No figures for this year, but the figures of the following year doubtless include both.

The following table shows the production of sugar in the Hawaiian Islands as a whole from 1877 to 1891, at which time the Hawaiian Sugar Planters' Association began issuing detailed statistics of production:

Years	Quantity Lbs.
1877	25,575,965
1878	38,431,458
1879	49,020,972
1880	63,584,871
1881	93,789,483
1882	114,177,938
1883	114,107,155
1884	142,654,923
1885	171,350,314
1886	216,223,615
1887	212,763,647
1888	235,888,346
1889	242,165,835
1890	259,789,462
1891	274,983,580

From 1891 to 1907 the production by islands is shown by the following table:

	1891.	1892.	1893.	1894.	1895.	1896.
Hawaii	76,866	58,551	57,078	72,199	61.643	109,299
Maui	36,110	28,390	32,670	33,689	27.735	29,097
Oahu	8,979	10,695	19,864	18,843	17.433	33,782
Kauai	24,219	24,643	43,009	41,704	42,816	51,650
Total	146,174	122,279	152,621	166,432	149,627	225,828

	1897.	1898.	1899.	1900.	1901.	1902.
Hawaii	126,736	91,606	117,239	115,224	134,618	121,295
Maui	41,047	45,033	54,389	57.347	58,349	56,726
Oahu	28,929	34,181	45,820	53,625	99,534	107,870
Kauai	54,414	58,594	65,359	63,348	67,537	69,720
Total	251,126	229,414	282,807	289,544	360,038	355,611

	1903.	1904.	1905.	1906.	1907.
Hawaii	170,665	122,865	126,405	137,750	143,891
Maui	84,776	77,985	100.434	102,960	104,772
Oahu	121,066	102,019	123,095	113,750	119,273
Kauai	61,484	64,606	76,314	74,753	72,081
Total	437,991	367,475	426.248	429,213	440,017

It may be noted in this connection that the small quantity of sugar produced at Molokai by the Kamalo Sugar Company and R. W. Myer, and perhaps others, is not included in the above, but

this amount is relatively very small, and the statistics of yields are not available.

Average Yield.—From 1835 up to say 1850-1855, with the methods of cultivation then in vogue and with the use of the most primitive mill apparatus, it was considered that one ton of sugar per acre was a fair average yield.

In 1882, there then being upwards of sixty mills in operation, a statement of production and acres harvested was obtained from each plantation with the following result:

	Acres	Tons (2000 lbs.)
Island of Hawaii	11,260	28,734
Island of Maui	5,037	13,482
Island of Kauai	3,459	11,671
Island of Oahu	1,779	4,764
Island of Molokai	259	473
Total	21,894	59,124

This gives an average yield per acre of 2.71 tons of sugar. It was stated at that time that this was the largest average yield per acre that the Islands were capable of producing in an ordinary season, and it was improbable that the future sugar crop would much exceed the total, at least for some years.

In 1889 the total number of acres under cultivation in the Islands was shown as follows:

	Plant Cane	Ratoons	Total
Hawaii	21,960	13,912	35,872
Maui	8,097	3,320	11,417
Kauai	5,744	4,009	9,753
Oahu	2,072	1,523	3,595
Molokai	75	75	150
Total area under cultivation	37,948	22,839	61,787

The yield from the area actually harvested is not given with the foregoing figures, and they are interesting only as showing the steady enlargement of the area under cultivation in sugar.

It would appear that during these years (1882-1889) a yield of 3 to 3½ tons per acre from plant cane and 2 tons an acre from ratoons was considered a very good average.

No systematic attempts to record areas harvested and production thereof was made until after the beginning of the Experiment Station conducted by the Planters' Labor & Supply Company. In the year 1897 this station inaugurated a system of returns from the plantations showing acreage and production. In some instances the totals of production are at variance with those shown above, but this is to be accounted for in the different man-

ner in which returns are made to the Experiment Station and to the Secretary of the H. S. P. A. In some instances the Station obtains returns from independent planters which do not enter into the figures of production furnished the secretary:

OAHU.

Year	Acres	Tons of Sugar	Yield per Acre, Lbs.
1897	5,368.5	28,929.	10,777
1898	5,373.14	34,181.	12,723
1899	6,233.	45,820.	14,702
1900	7,265.5	53,625.	14,761
1901	13,562.	98,897.	14,584
1902	15,183.	107,770.	14,196
1903	16,684.	121,066.	14,513
1904	15,832.	102,019.78	12,888
1905	18,782.84	123,094.76	13,107
1906	18,178.	113,363.2	12,473
1907	18,994.64	119,272.46	12,559

KAUAI.

1897	9,714.	54,414.	11,203
1898	10,864.	58,594.	10,787
1899	11,109.	65,359.	11,767
1900	11,862.	63,348.	10,681
1901	12,896.	67,205.	10,423
1902	14,320.	69,694.	9,774
1903	13,291.	61,484.	9,252
1904	14,959.15	64,603.47	8,637
1905	16,541.82	76,313.42	9,227
1906	17,096.2	74,787.7	8,749
1907	16,289.49	72,194.68	8,864

MAUI.

1897	8,693.5	41,047.	9,443
1898	8,269.5	45,033.	10,891
1899	9,295.75	54,389.	11,702
1900	10,425.	57,347.	11,002
1901	11,400.	58,349.	10,237
1902	11,920.	56,616.	9,499
1903	14,625.	84,776.	11,593
1904	13,948.8	77,926.	11,173
1905	15,116.46	100,433.77	13,288
1906	15,971.4	102,961.60	12,893
1907	16,724.5	104,772.47	12,529

HAWAII.

1897	30,107.	126,736.	8,419
1898	30,728.5	91,606.	5,962
1899	33,671.	117,239.	6,963
1900	34,264.	115,224.	6,726
1901	40,760.	134,682.	6,608
1902	39,531.	119,870.	6,064
1903	48,750.	170,728.	7,004
1904	47,057.670	122,855.54	5,281
1905	45,002.390	127,523.73	5,667
1906	44,984.000	139,255.7	6,191
1907	47,907.370	144,694.55	6,041

HAWAIIAN ISLANDS.

1895	47,399.5	153,419.5	6,472
1896	55,729.	227,093.	8,148
1897	53,825.5	251,126.	9,331
1898	55,235.5	229,414.	8,306
1899	60,308.	282,807.	9,378
1900	63,816.	289,544.	9,074
1901	78,618.5	359,133.	9,136
1902	80,954.	353,950.	8,744
1903	93,350.	438,054.	9,385
1904	91,797.66	367,405.07	8,005
1905	95,443.51	427,365.68	8,955
1906	96,229.6	430,368.2	8,945
1907	99,916.	440,934.16	8,826

In considering at the present time the tremendous increase in production shown by the above figures, it is interesting to note some of the remarks or predictions made in the early days as to the possible output of sugar in the Hawaiian Islands In 1882 the following statements and estimates were made up "by gentlemen thoroughly conversant with the subject, and are reliable:"

Name of Island	Acres of Cane Land		Acres Annually Cropped		Annual Yield of Sugar in Tons	
	Present	Possible	Present	Possible	Present	Possible
Hawaii	30,000	40,000	12,000	18,000	29,000	40,000
Maui	12,000	14,000	6,000	7,500	15,500	25,000
Oahu	3,000	3,500	1,500	2,000	3,000	4,000
Kauai	10,000	15,000	4,000	6,500	9,500	15,000
Total	55,000	72,500	23,500	34,000	57,000	84,000

In 1883 we find the following reliable statement in reference to the limit of production in the Hawaiian Islands:

"From an estimate which we have obtained from a most reliable source, the Hawaiian Islands have only about 100,000 acres which can be termed sugar lands; but even of such lands we cannot make full use, either on account of our scanty water supply or on account of location. On the Island of Hawaii for instance, though as far as soil is concerned, there are some tracts of land which to the uninitiated seem admirably fitted for cane, they are useless; if over 1000 feet above the sea level they will yield a crop in 30 months, and few men are bold enough to face such a lengthy period before they get any return for their money and work, let alone the ordinary risks which a planter is exposed to. On the same island, as a rule, to plant cane below 400 feet from the sea level is dangerous on account of the drought. Thus on our largest island, the one offering the broadest tracts of land for cane cultivation, the area where this industry can be successfully carried on is considerably narrowed by mere position.

"At the present time we have 40,000 acres under cultivation for cane; and of this about 26,000 acres are cropped each year. Could we, which is as far as we understand practically impossible, but for the sake of argument we may say, *could* we cultivate the whole 100,000 acres we could not crop more than 52,000 acres each year. Now from last year's crop of 26,000, there were produced 56,000 tons of sugar, or about two and one-sixth tons to the acre, taking things by and large throughout the group. A great deal of nonsense is written about the productiveness of our soil; true that in some exceptionally favored spots, rich valley bottoms, and even then only for the first crop planted, as much as five or six tons to the acre have been obtained; but such places are exceptional, and the statistics of the yield of 1882 conclusively prove that the average yield of the cane lands in these islands is very little better than it is anywhere else. The very utmost, then, that we could get from our sugar lands would be about 100,000 tons a year. Practically we can never obtain any such crop, for though the land may be there the elevation and the lack of water are an insuperable barrier to our making use of them. As a fact Hawaii has very nearly reached her limit of production, and what she produces is not a drop in the bucket when compared with what the United States consume."

Even as late as 1893 it was authoritatively stated that the limit of production of the entire group was 150,000 tons.

In view of all these predictions it is somewhat of a relief to quote from a report by Dr. H. W. Wiley of 1899, who states: "From the most reliable information accessible it may be said that under the stimulus of American enterprise the Hawaiian Islands will produce for export to the United States about 500,000 tons of sugar in 1910," the total production of the Islands then being 282,807 tons.

For general statement of development as compiled by the Bureau of Census, 1900, see Bulletin No. 169 of the 12th Census of the United States issued May, 1902.

Causes of Increase.—The great development of the sugar industry of Hawaii since 1876 is due to a great many causes, of which may be enumerated the following as being the principal factors in development:

First, the granting by the United States of the reciprocity treaty of 1876 followed by annexation of the Islands in 1898.

Second, improved machinery and improved methods in cultivation, including the use of fertilizers.

Third, irrigation: conservation of mountain water and the development of the artesian well supply.

Fourth, the coöperation of the various plantation interests, both in the formation of an association of the planters and the organization of an experiment station.

Reciprocity Treaty.—In 1855 a reciprocity treaty was negotiated by W. L. Marcy, Secretary of State for the United States, and Judge Lee, representing the Hawaiian government, but though the Committee on Foreign Affairs approved of it, the treaty failed of ratification in the Senate. Later, in 1867, the treaty was again ratified by the Hawaiian government and approved by President Johnson and W. L. Seward, Secretary of State, only to fail once more of Senate approval. At last in January, 1875, the United States entered into a treaty of commercial reciprocity with the Hawaiian Islands, which after some delay went into operation September, 1876, and remained in force until annexation of the Islands to the United States. By the terms of this treaty the leading agricultural products of Hawaii including rice and raw sugars, (known in San Francisco as "Sandwich Island Sugars") were admitted free into all ports of the United States; and nearly all the agricultural products and manufactures of the latter nation were admitted free into Hawaii for the term of seven years from the date at which it went into operation, and further, until twelve months' notice of termination should be given by either of the contracting parties, after the end of said term of seven years. (For the full text of the reciprocity treaty see Thrum's Annual for 1877, page 12.)

The commercial advantages to the United States were considered but little in the granting of the treaty, political or state considerations being the controlling reasons. The measure was supported by both the Republicans and Democrats in Congress and was granted, so far as the United States was concerned, for the purpose of securing political control of the Islands, and making them industrially and commercially a part of the United States, and preventing any other great power from acquiring a foothold in the Islands, which might be adverse to the welfare and safety of the Pacific Coast in time of war.

From the report of the Committee on Foreign Relations of the United States Senate in 1894 the following excerpt which con-

tains the statement that one of the controlling considerations in making the treaty was that Hindus were to be imported into the Islands to supply needed labor, which under British regulations would have meant a certain measure of British control of said laborers, which might have lead even further. The statement is as follows:

"The islands prior to the treaty were declining in population, and owing to the decay of the whale fishery, were declining in wealth. Their soil is, perhaps, the most productive for sugar raising of any known in the world. But the high tariff on sugar and the exceedingly low wages which must be paid in tropical countries for raising sugar to supply the United States rendered the industry difficult. In 1875 a movement arose in the islands for the importation of Hindoo coolies to supply the requisite cheap labor, and the consent of England was promised. The growth of the Australian colonies had gradually developed an improving market for Hawaiian sugar, and, after a trial of it by some of the Hawaiian planters, it was found that better prices could be obtained in the free-trade port of Sydney than in San Francisco, and return cargoes could be bought there much more cheaply. Preparations were making for sending there the entire crops of 1876-77. These matters came to the knowledge of the State Department. The Hawaiians had been pressing for many years for a commercial treaty with the United States, but without success. It was now felt in the State Department that the question was assuming graver importance, and, as political supremacy in the islands must inevitably follow the commerce, it was recognized that this country must make favorable concessions to them, or else let them follow the inevitable tendency and drift slowly into the status of an English colony. The result was the negotiation of the existing treaty and its ratification by the consent of the Senate."

The treaty of reciprocity gave Hawaii its first great impetus in trade and developed a tremendous activity in production, which has continued to the present day. The impetus which the treaty gave to the sugar business has produced results which were not anticipated, and which have been most far-reaching, both in the effect upon Hawaiian industry and trade, and upon the industries and shipping of the mainland.

New life was infused into every branch of business in the Islands, capital from the United States was attracted and invested, the population increased, the commerce of the United States developed to a remarkable degree, and the American influence in the Islands increased and predominated to a very great extent.

As trade grew and prospered it was demonstrated that the balance was not all on the side of the Hawaiians. Hawaiian production (principally sugar and rice) as shown in the tables to follow, within a short time increased fourfold, while imports into Hawaii of the products and manufactures of the United States increased in almost a like ratio. A large number of vessels both

sail and steam were built in the United States for trade between the States and the Islands and also for inter-island trade. It was not long before a new line of steamers was established between San Francisco and Honolulu, and a line of sailing vessels between Honolulu and New York. The development of American shipping due entirely to the production of sugar is one of the remarkable and permanent results of the admission of Hawaiian sugars into the United States free of duty.

The development of the sugar mills and the improved machinery used by the plantations, nearly all of which has been obtained from the United States, has given large returns to American factories and has afforded employment to thousands of American mechanics and laborers.

To go into the details of the effects of the treaty and of annexation, upon all the various lines of business directly relating to the production of sugar would be to carry this report to a point where it would be much too voluminous.

In 1886, during one of the periodical efforts made by mainland interests to obtain abrogation of the treaty, the situation was very well summed up by the United States Consul-General at Honolulu in a report to his Government, as follows:

"As the tables herewith given clearly show, the benefits of reciprocity do not all come to the people of the Islands. The 200 ships which have cleared from this port during the year were built by American shipbuilders and are the property of American citizens. The loss of the treaty is a certain loss of the business of these vessels and a large per cent. of the capital invested in them. Two-thirds of the capital invested in plantations and the facilities for the production of sugar is the capital of Americans. Three-fourths of the money borrowed for the prosecution of the sugar business in the Islands comes from American banks. All the immense investment in the two great refineries in San Francisco is American. Seventy-five per cent. of the insurance on vessels and cargoes is placed in American companies. Three-fourths of all the imports into the Kingdom are the production of American farms and manufactories, and after the expenses are paid and the dividends struck, almost the entire profits find their way to the States for permanent investment. But this is only the dollars and cents view of the matter."

A majority of the Senate Committee on Foreign Relations in 1884 reported against abrogating the treaty, and, in their conclusion, stated that "whatever objections have been found to the workings or the results of this treaty are greatly overbalanced by the advantages we have acquired in a national sense; and by the benefits to our people of a profitable trade with the Hawaiian people, and by the duty we owe the people of both countries to give certainty and permanence to the gratifying prosperity which this treaty has created."

For detailed statements showing the operation of the treaty from a commercial standpoint from its beginning, see the following:

Report of Committee on Foreign Relations, U. S. Senate, 1894, Vol. 1, page 103.

Planters' Monthly, Vol. 1, pp. 188, 245.

Planters' Monthly, Vol. 2, pp. 328-335.

Annexation to the United States.—Annexation to the United States in 1898 has been the greatest single factor in the development of the sugar industry of Hawaii since the reciprocity treaty. The sugar crop of 1897-1898, the last before annexation, amounted to 229,000 tons. By 1901 it had reached 360,000 tons, and for the present year, 1908, will be 520,000 tons. The immediate effect of annexation was to establish confidence in the stability of government and a free protected market for sugar, both of which had theretofore been lacking, with the reciprocity treaty liable to be repealed at any time at a year's notice, and the subject of constant hostile attack in Congress.

As a result of this confidence there was a boom in establishing sugar plantations; Olaa, Puna, the Portuguese Mill, the Kona Sugar Company and Puako, being established on Hawaii; Kihei and Nahiku on Maui; Maunalei on Lanai; Kamalo and American Sugar Company on Molokai; Honolulu and Waialua on Oahu, and McBryde on Kauai. Oahu plantation was started just before annexation. In addition to the above named new plantations, every plantation on the islands that could secure additional land or water, proceeded to expand as much and as rapidly as possible. In connection with railroads and other new concerns started at the same time, enterprises were initiated in Hawaii, within eighteen months after annexation, involving capital of over forty million dollars, ninety per cent. of which was subscribed for by residents of the islands. The inevitable followed. The boom got ahead of the available capital. Several of the enterprises failed and financial stringency was the rule all along the line. In spite of this, the enterprises were, in the main, on solid foundations, and the Territory is once more on its feet, with the sugar business as a whole, better developed, better organized and more intelligently handled than ever before.

DEVELOPMENT OF PLANTATION EQUIPMENT AND IMPROVED METHODS OF CULTIVATION.

Most of the sugar planters of this generation would undoubtedly say if asked that the machinery for the extraction of sugar as represented in a modern 12-roller mill and other apparatus of the same high grade has developed as far as it is possible to go with economic success.

A similar view in reference to the 5-roller mill was held by experienced sugar planters in 1883. A committee of the Planters'

Labor and Supply Company in that year stated, "That no method has as yet been invented for extracting juice from cane, that it is at all certain will supercede the three or five-roller mill. There is from eight to ten per cent. of saccharine matter in cane, but no method has as yet succeeded in extracting in a manner that will pay where fuel is expensive. Inventors have done their duty and puzzled their brains over this waste. The diffusion process will extract all the saccahrine juice, but applied to cane it has not as yet proved altogether a success. Maceration mills will extract nearly all the saccharine matter, but we think it doubtful whether they would pay here where fuel is so expensive."

It would be very interesting to trace in detail the rapid development of sugar mills and machinery since 1876, or even earlier, but for the purpose of this report a brief mention of the more important improvements is all that is necessary.

Going further back it perhaps should be stated that the first mill to manufacture sugar, for export, was erected at Koloa in 1835, seed for the plantation being obtained from indigenous cane in the neighborhood with much difficulty on account of the opposition of the chiefs of Kauai. Another locality on Kauai, Kekaha, also claims the distinction of having the first sugar mill, which was hewn out of ohia timber by Mr. Whitney, one of the pioneer missionaries, and was used in the manufacture of sugar and molasses as early as 1820. All these very early mills had wooden rollers worked by animal power. The mode of sugar boiling was by the open train, with whale ship trypots.

The number of plantations in operation in 1861 were 22, of which 9 used steam as motive power in grinding and 12 were driven by water, and one by animal power. Just previous to the treaty of reciprocity the number of plantations stood at from 30 to 33, while in December, 1877, 15 months after the promulgation of the treaty there were 46 plantations. In many locations cane planting on the coöperative plan was largely entered into, the cane being ground by the mills already existing or to be erected.

The history of the Hawaiian cane-crushing mills may be divided into three topics:

First, single 3-roller mills, used exclusively up to 1885 and in some instances later;

Second, an addition of one or two 2-roller mills to the original 3-roller mills in all sugar houses;

Third, the introduction in 1894 of the 9-roller mill, and in 1905 of the 12-roller mill.

With the 3-roller mill it may be safe to state that 60 pounds of juice extracted from 100 pounds of cane was considered satisfactory mill work, and 70 pounds of juice exceptionally good extraction.

With such extraction the bagasse contained so much water that it would not burn, and it required coal as fuel at approximately the ratio of one pound of fuel for two pounds of sugar manufactured. A large number of laborers was required to spread the

bagasse on the ground and open it up so that the sun could dry it before it was gathered and carried into the bagasse houses where it took from two to three weeks to dry so that it would burn readily.

The first additional rollers were installed at Waiakea Mill and followed later by all the plantations. The great advantages derived from the use of one or two additional 2-roller mills, arranged to grind the partly crushed cane from the single 3-roller mill were then, comparatively speaking, of vastly greater importance than any other mill improvements which since then have taken place. These advantages were principally in the additional crushing of the partly ground cane producing a much better juice extraction; the moisture in the bagasse being reduced to such an extent that the bagasse would burn directly as it came from the mills after the grates had been reconstructed and thereby making it possible to get along without extra fuel, saving the enormous expense of wood and coal; and the application of hot water, maceration, to the partly crushed cane passing between the mills, thereby assisting the mechanical "squeezing out" of the juice by washing the sugar out of the opened cane cells, resulting in greater sugar extraction than it had so far been possible to obtain.

The next great epoch in the Hawaiian mill evolution was inaugurated by Ewa Plantation Co., when in 1894, on Mr. H. P. Baldwin's recommendation, they imported the first 9-roller mill from the Fulton Iron Works Co., St. Louis.

The principal feature of this milling plant is three 3-roller mills resting on one bed and coupled up to one common gearing, giving each succeeding mill a slightly increased speed over the former mill, and all driven by one engine, generally of the Corliss type with automatic "cut-off", insuring regular speed. Each mill is fitted with independent and adjustable hydraulic pressure on the top roller, ranging from 300 to 450 tons. The main point which gives this style of mill such a great advantage over the former 5 and 7-roller mills, is the absolute uniform relative speed, and therefore feed, of the mills, the most essential requirement for obtaining the best possible extraction of juice.

In all the large new 34x78 9-roller mills, and in a number of the 32x60 9-roller mills in the islands, cane preparers are now installed in connection with the first mill. These are either two-fluted and grooved rollers as made by the Fulton Iron Works Co., two deeply cut zig-zag shaped rollers meshing into each other, as made by the Krajewsky-Pesant Co., or the two fast revolving drums with conic rings shredding the cane lengthwise, called the National Cane Shredder. These machines have all the same object, to prepare the cane before it enters the first mill by cutting it up in small pieces, filling up the holes between the rollers, and evening out an irrgular feed of the cane. The result obtained is not so much marked by an increased extraction in the mills, as it is by increasing the capacity from 20 to 30 per cent., and securing regularity of feed, a great point in milling.

A modern 9-roller mill consists therefore of eleven rollers through which the cane passes, getting seven crushings. The bagasse escapes finely divided and is fed automatically to the furnaces, and with a moisture content of about 43 per cent. it burns freely, and furnishes ample steam for all sugar house work and 17 to 18 per cent. of hot maceration water can be applied to the partly ground cane between the mills, greatly assisting the sugar extraction.

The 12-roller mill consists of the addition of three more rollers the effect of which is to give better extraction and a correspondingly larger capacity.

The diffusion process first came into use in 1884, and for a time promised to take leading place in the extraction of juice from sugar cane, and had it not been for the success attending the introduction of the 9-roller crushing plant, would probably have been installed on many plantations. The extraction obtained by a well conducted diffusion plant and the first 9-roller mills was approximately the same, but the expense of operation was largely in favor of the mill.

Before leaving the subject of mills, and as a matter of interest merely, we insert here a description of an early Chinese plant, and following it a description of one of the modern mills:

Chinese Method of Manufacturing Sugar in 1839.—"While on a visit to Waimea, Kauai, a year or two since, I happened in at a sugar-mill then in operation under the management of three Chinamen; it being the first establishment of the kind I had ever seen in operation, I was induced to spend nearly an hour in noticing the mode which the Chinese adopt in producing sugar from the cane; I herewith send you an outline of the mill, as it then stood; and a partial description of their method of setting sugar pans.

"Some ten or a dozen upright posts supported a straw roof which protected from the sun the mill, boilers, three or four jaded horses and a score of hogs, which at times seemed to claim a part of the juice which flowed from the mill. In the center of the building a heap of earth was thrown up, in which were implanted two upright posts of rough granite, their upper ends being hewn off to something resembling a tenon; a plank extended from one post to the other, having in it two mortices to receive the tenons; also, two circular holes to receive the necks of two rollers. These rollers were of granite, about two and a half feet in diameter, and two feet high, and were morticed near the top at proper distances to receive wooden cogs, which apparently were made with no other tool than a broad ax. The bed of the mill was a granite slab imbedded in the earth, and had in it two round holes to receive the lower necks of the rollers; also, a channel extending from four to five inches round the rollers, the outlet to which (when the lump of mud was received) allowed the juice to flow through a gutter under the horse-walk to a small tub. The necks of these rollers were all of wood, about six inches in

diameter, and their bearings protected by an iron band. On one of these was secured the arm or lever to which the power was applied; this arm was merely the branch of a tree (imported with the rollers). Some pains must have been taken to select one whose natural crook should answer the purpose; it was secured to the neck of the roller by a rope; a single horse attached to its end, with a plentiful application of the lash, gave motion to the rollers. He whose business it was to feed the rollers with cane seated himself in front of them, and generally kept three or four sticks of cane between the rollers, allowing it at first to be gently squeezed, the second time more so, and on passing it between the rollers the third time it was also drawn through a stout funnel, which effectually took all the remaining juice.

"The evaporating pans contained about twenty gallons each, and were set triangularly. The furnace was built of sun-burnt bricks, 18 inches long, 9 wide and 6 thick. These bricks (if they can be so-called) are made of common earth, hens' feathers, goats' hair, hogs' bristles, and water, and laid up with the same compound; the mouth of the furnace was about two feet high by one foot wide, and directly over it was a small hole to allow the smoke to pass off. The capacity of the pans was increased two-fold by extending the brick-work two feet above the rims; this brick-work was protected from the action of the syrup (at least for a time), by being covered with mats, tapas, banana leaves, lime, brick dust, etc.

"Pan No. 1 seemed to be used for a clarifier only, and was separated from the other by two boards projecting from the brick-work to a common center. Pans 2 and 3 served for evaporations, and, when the ebulition was great, flowed into each other; this was prevented by occasionally throwing in a small quantity of an offensive, greasy preparation, the principal ingredient of which is the lees of ground-nut oil.

"The syrup was concentrated in pan 3, thence removed to cooler. 4. To ascertain when the syrup had arrived at the crystalizing point, a small coarse-grained stone, made for the purpose, was placed in the bottom of a saucer of cold water, on which a portion of the syrup was dropped; the boiler rubbing his thumb over it soon determined whether it was sufficiently boiled. From the cooler it was removed to conical clay pots holding about 20 pounds each. These pots were not filled till after three successive boilings. I noticed the Chinese did not *clay* their sugar, but used rice straw well saturated with water; this was placed on top of the sugar-containers to the depth of three or four inches, the water from which passing through the sugar removed all the molasses.

"This sugar was crushed and exposed to the sun before sending to market.

"The mill, indeed the whole apparatus, was exceedingly rude,

but it appeared to answer a good purpose. I was told that they had made 300 lbs. of sugar per day with it.

"It is to be regretted that some plan could not have been devised which would have rendered it for the interest of all concerned to keep the mill in operation."—Hawaiian Spectator, Vol. II, 1839.

Description of a Modern Cane Sugar Milling Plant.—The following is a description of a modern cane sugar factory, which will handle from twelve hundred to fourteen hundred tons of cane in twenty-four hours, making from one hundred and seventy-five to two hundred tons of 96 degree sugar in that time.

Crushing Plant.—The crushing plant will consist of four three-roller mills, the rolls being thirty-four inches in diameter and seventy-eight inches long; preceding these is a preliminary, two-roller crusher, for preparing the cane for the subsequent milling, the cane being delivered from the plantation cars or flume into a long conveyor, by automatic unloaders, for feeding to the mills.

Boilers.—A conveyor extends from the last set of rollers to the boiler room, delivering the bagasse, which is practically exhausted of its sugar and quite dry, into an elevator and conveyor, from which it is automatically fed into the boiler furnaces.

There are eight horizontal, tubular boilers, seven feet in diameter and twenty feet long, with their equipment of automatic furnace feeders, grate bars, flues, piping, etc., and a steel smoke-stack, of the self-supporting type, ten feet in diameter and one hundred and seventy-five feet high.

Clarification System.—The clarification system consists of twenty settling tanks, having a capacity of from twelve to fifteen hundred gallons of juice each, together with proper exhaust and live steam heaters, liming tanks, etc.

For filtering the scum from the settling tanks there are twelve presses, each having five hundred square feet of filtering surface.

Evaporating System.—The evaporator is a quadruple effect, having a capacity of fifteen hundred tons of juice per twenty-four hours, reducing it seventy-five per cent. in volume.

Vacuum Pans.—There are three vacuum pans, each of twenty-five tons capacity, or one large pan, of fifty tons capacity, and one pan of twenty-five tons capacity, one of the pans being used for the low grade product. These pans, together with their equipment of syrup and molasses tanks, are located on the third or upper floor of the factory building.

Crystallizers.—For the further treatment of the sugar, after it leaves the vacuum pans, there is a battery of twenty crystallizers, each being of sufficient capacity to hold the contents of the twenty-five ton pan. These are placed on the second floor, immediately below the vacuum pans.

Centrifugals.—For drying the sugar, after delivery from the crystallizers, there are twenty centrifugals, each forty-two inches in diameter. These centrifugals, which may be either belt, water

Fig 1

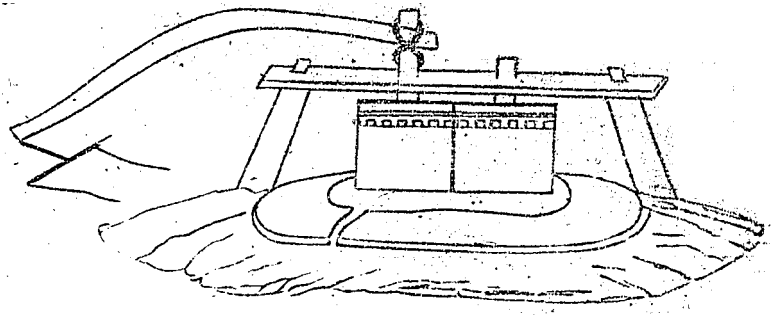
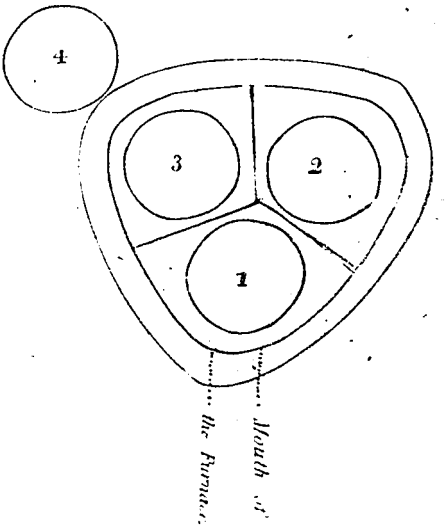


Fig 2



Chinese Sugar Mill.

Eng by Exham

or electrically driven, as may be preferred, with their equipment of mixers, conveyors, dryers, elevators, bagging pins, etc., are placed between the ground floor and the second floor of the factory building.

Condensers.—For condensing the vapors from the pans and evaporators, all of which are operated under a vacuum, and for the removal of the uncondensable gases, a central condensing plant is installed, which consists of a condenser for each of the pans and evaporators, and an auxiliary condenser from which the central condenser vacuum pump takes its suction.

Electrical Equipment.—For auxiliary power throughout the factory, for running cane unloaders, revolving cane knives, driving the crystallizers, conveyors, elevators and machine shop apparatus, and for lighting the factory, an electrical plant of one hundred and fifty kilowatts is installed.

Water Supply.—The necessary water supply will approximate five million gallons per twenty-four hours, and can be supplied either by gravity or by a pumping system.

Sugar Chemist's Laboratory.—A complete sugar chemist's laboratory is installed, with all the necessary apparatus, for a thorough chemical control throughout the different processes of manufacture.

Machine Shop.—There is a complete machine shop, equipped with lathes, drills, planers, pipe cutters, etc., and the necessary hand tools, so that ordinary repairs may be expeditiously made.

Pumps and Piping.—In connection with the above machinery there is a complete equipment of pumps and pipe lines, throughout the building, for handling the juice, syrup, molasses, water service, boiler feed, etc.

Building.—All of this machinery is contained in a steel frame, corrugated iron building, of specially heavy construction.

The boiling house is three stories in height, the clarification department two stories, and the milling and boiler house department one story.

In the mill room a heavy crane spans the full width of the building, and has a traverse of the extreme length of same, so that the heavy mill rollers may be readily handled for adjustment and repair.

Cost.—The cost of a factory of the above dimensions would be about $650,000.

Other sugar apparatus has developed along the same lines as the extraction machinery. The Weston Centrifugal, invented by D. W. Weston in Honolulu, was first used in 1852 at Makawao. It was run by man power, and the first machine was such a curiosity that throngs of Hawaiians came to watch its operation, and it is stated that school boys would come every afternoon and run the machine till night without pay, and would dispute their turn at running it.

Very many improvements have been made in the centrifugal since that time, but the original idea has remained the same.

Hydraulic attachment to the mills was adopted at the time of the 5-roller mills, thereby very largely increasing the extraction. Vacuum pans were introduced in 1863 with double and triple effects in 1878, and mud presses came in generally about 1880.

CULTIVATION.

Improved methods of cultivation followed hand in hand with improved sugar machinery. Very early attention was given to the planting of the best seed, and there was much discussion in the early meetings of the Planters' Labor and Supply Company as to the relative values of seed from plant cane, from ratoon cane or from the tops of either plant or ratoon.

A great deal of attention was given to the best varieties of cane to plant. Climatic and soil conditions varied so much in different localities, or even upon the same plantation, that a variety of cane which might do well at a low elevation would give a small yield at a higher elevation, and so while Lahaina cane was the favorite cane for many years, and still remains so, in favored localities, other varieties were tried and are yet being tried and experimented with.

Improved agricultural implements have been brought into use, steam plows were first introduced about 1880 or 1882, and various kinds and makes of cultivators and horse-plows have come into use. The investment of the plantations in agricultural implements, most of which came from the United States, reaches a very large sum, and the up-keep and replacement of such appliances is a continual expense.

For many years the principal method of transporting sugar cane from the fields to the mill was by ox-cart or mule teams. As late at 1882 there were only eight plantations that used steam railways for transportation. Recent information of the mileage of steam railways on plantations is not available, but in 1905 there was a total of 534 miles of permanent track owned by the plantations, 88 locomotives and 7796 cars. The investment in rails and rolling stock is thus very considerable.

Many labor saving devices for use in cultivation and harvesting have come into general use, but nothing has yet been invented which will mechanically harvest the same. Cane loaders are in use on some plantations, but they do not greatly reduce the cost of their operation.

Fertilizers.—One of the most important factors in the matter of increase of yield due to improved cultivation, is the use of fertilizers. It would seem that fertilizers were first used on the plantations here in 1879. In the Hilo district it had become apparent that the soils were not yielding as well as they had, and in that year various samples of soil at Onomea were sent to New York and were there analyzed, and fertilizers composed largely of sulphate of lime were recommended. From this the question of fertilizer grew. With the intensive agriculture such as is prac-

ticed in these islands in the cultivation of sugar cane, and where rotation of crops is not followed, it became a very important one. Owing to the wide diversity of conditions with regard to climate and soil which characterize the sugar lands of the country it became manifest that the subject of fertilization was one which must be worked out in large measure for each individual plantation. Not only must the needs of the crop be taken into consideration and weighed with relation to the quantity of plant foods stored up in the soil, but the form in which the various fertilizer ingredients to be added to render the best service, constituted a subject of equal importance.

When the Hawaiian Sugar Planters' Association established its Experiment Station in 1895 there began a systematic examination of soils both on the plantations and in the laboratories, together with the collection of data as to rainfall and temperature, which has been the basis of much of the fertilizing that has been done since that time. And it is due in a very great measure to these investigations of the conditions of each plantation that the fertilizers used in one district are so different now from those used in another district, and that there is a constant tendency toward high grade fertilizers which are specially prepared for the plantations where they are to be applied.

The amount of fertilizer sold in Hawaii has increased tremendously, as the following table will show. The custom house reports from the year 1885 to 1888 show the following imports:

Year	Pounds	Tons	Value
1885	2,050,689	1,025	$ 30,568.92
1886	2,747,052	1,374	36,162.80
1887	4,140,207	2,070	52,302.76
1888	5,976,271	2,988	100,879.26

The sales of fertilizers for the past five years by the two fertilizer companies operating in Honolulu has been as follows:

1904	1,732,470
1905	1,974,235
1906	2,300,023
1907	2,383,195

Authentic figures of the amount sold to the plantations by fertilizer companies in San Francisco are not to be obtained, but are closely estimated at about $75,000 per annum. In addition to this, one sugar agency imports approximately $100,000 worth of nitrate of soda per annum.

Irrigation: Irrigation by Mountain Streams.—When the growing of sugar cane was first started on these islands the plantings were made on the windward side of the islands to take advantage of the rainfall, and it was not until some years after the inception of the industry that it became evident that the rainfall was not regular enough, excepting in some few places, to produce the best results in cane culture, and hence the first attempts at irrigation

were accomplished by damming up the streams and leading the water out by means of ditches to the head of the cultivated lands.

One of the most striking features in connection with irrigation and the conservation of mountain water is the extraordinary productiveness of some of the island water sheds. The Waihee shed on Maui, with an area of about four square miles, yields a daily minimum flow of 17,000,000 gallons, while the Olokele shed on Kauai, with an area of about eight square miles, yields a minimum flow of 40,000,000 gallons, and a mean flow of 70,000,000 gallons in 24 hours. Each of these water-sheds is particularly and favorably situated for precipitation with brush covered steep slopes and with almost daily rainfall.

Nearly all the Hawaiian streams respond very quickly to rainfall, rising and falling quite readily, while those with a good dense brush covered water-shed hold the volume in streams almost constantly above a certain minimum.

The first ditch for the irrigation of cane was dug at Lihue, Kauai, at a cost of about $7,000 in the year 1857. There were no engineering difficulties. The results were disappointing at first due to the ignorance of the best method of applying the water, but later experience made Lihue one of the best paying sugar plantations in the islands.

The Hamakua Ditch.—In 1876, under the initiative of H. P. Baldwin and S. T. Alexander, a company was formed to bring water from the windward slopes of Haleakala to the Haiku, Paia and Grove Ranch plantations. The ditch was 17 miles long, with a daily capacity of upwards of forty million gallons. It involved crossing precipitous gorges up to 450 feet in depth, inverted syphon riveted pipes, of a diameter of forty inches being used, and cost $80,000.

The Hawaiian Commercial Ditch.—The next "big ditch" to be dug was into the same territory, but below the Hamakua ditch. It was financed by Claus Spreckels and engineered by H. Schussler; was thirty miles long, with a daily capacity of fifty million gallons, discharging at a head of 250 feet. In 1900 this ditch was intercepted near its head and supplemented by the Lowrie ditch. This ditch has a daily capacity of sixty million gallons, and delivers water onto the cane fields at an elevation of 450 feet.

The Waihee Ditch.—Several years later the Hawaiian Commercial Company built a ditch from Waihee to its cane fields, reaching almost to Maalaea Bay, about ten miles, from which an average daily flow of 35,000,000 gallons is obtained.

The Makaweli Ditch.—No further development in ditch building took place until the establishment of the Makaweli plantation in 1890. This ditch was over fourteen miles long, including 7,040 feet of 40-inch riveted steel syphon pipe; 1,013 feet of tunnels; 14,618 feet of flume five feet wide by forty inches deep, and delivers 35,000,000 gallons per day at an elevation of 450 feet.

Ditching After Annexation.—With the exception of a short ditch from Maunawili to Waimanalo, with a daily capacity of

4,000,000, there was little ditch construction until after annexation in the summer of 1898.

The Olokele Ditch.—The Hawaiian Sugar Company (Makaweli) added the Olokele ditch to its water supply in 1902-04. This ditch is thirteen miles long, through an inaccessible congeries of gorges and precipices, of which eight miles consists of tunnels, seven feet high and seven feet wide. It has a daily capacity of 60,000,000 gallons and cost $360,000.

The Koolau Ditch.—In 1903 the Hawaiian Commercial Company and the Maui Agricultural Company combined to extend their old ditch through Koolau and into the Nahiku district. This region is one of the best watersheds in the islands, but is such a tangled mass of deep gorges that it had been previously deemed unavailable for economic use. The same engineering tactics were adopted, however, that had proved so successful at Olokele. Although the ditch is only ten miles long, it crosses 38 valleys, requiring that number of tunnels through the dividing ridges, the shortest being 300 feet and the longest 2,710 feet long. The total tunnel length is seven and one-half miles. The tunnels are seven feet high and eight feet wide. The ditch has a daily capacity of 85,000,000 gallons, and cost $440,000.

Extension of Hamakua Ditch.—Coincidently with the construction of the Koolau ditch the Hamakua ditch was extended to meet it and the old ditch enlarged, to a capacity of 60,000,000 gallons per day, at a cost of $316,000. The total length of the ditch, from Nahiku to Kihei, is fifty miles.

The Honokohau Ditch.—In 1903 the Pioneer Mill Co. constructed a ditch from Honokohau through Kaanapali, Maui, a distance of thirteen and a half miles, of which three and a half miles is tunneling. It has a daily capacity of 30,000,000 gallons and cost $185,000. This plantation has also made a number of small ditches and done much tunneling for water in the adjacent valleys, with great success, one 2,600-foot tunnel, at an elevation of 2,500 feet, having produced a daily flow of a million gallons.

The Kohala Ditch.—The Kohala Ditch Company, an independent water company, has completed a ditch from the Kohala mountains through the Kohala district, furnishing water to the several existing plantations, with expectation of irrigating a large additional dry area toward Mahukona. The first section of this ditch, about 12 miles in length, was opened in June, 190.., with a flow of 20,000,000 gallons per day. The ditch is 18 miles long, with a daily capacity of 70,000,000 gallons. This ditch is also of the "tunnel variety," approximately nine of the twelve miles' length of the ditch being tunnels eight feet wide and seven feet high.

The Wailuku-Waikapu Ditch.—The Wailuku Sugar Co. and Hawaiian Commrcial & Sugar Co. have jointly constructed a 12-mile ditch from Waihee to Waikapu. This ditch is largely through tunnels. It has a daily capacity of 45,000,000 gallons.

Oahu Sugar Company Ditches.—The Oahu Sugar Company,

although mainly a pumping plantation, has constructed over fifty miles of ditches which intercept the storm water and a small regular flow from a number of valleys extending back into both the Koolau and the Waianae mountains.

Storage Reservoirs.—Incidental to both the ditch and pumping stations, is the system of storage reservoirs for collecting storm water from the ditches and night water from the pumps. The first reservoirs of any considerable capacity were constructed in connection with the Hamakua and Hawaiian Commercial ditches; but it is only since annexation that reservoirs have taken the prominence that they now occupy in connection with cane irrigation. The island of Hawaii has practically no reservoirs for storage purposes, except at Kohala, but a number will be built in connection with the Kohala and Hamakua ditches. Maui early took the lead in this adjunct of irrigation, but Oahu and Kauai have now waked up to the possibilities of water storage on a large scale and an increase in the number of storage reservoirs is planned on almost every plantation. On the pumping plantations the reservoirs are used to store the night and Sunday water, the pumps working continuously. It is not good economy to irrigate at night, and only necessary work is done on Sundays. The method of construction of the great majority of these reservoirs is extremely simple. A shallow gulch or swale is selected, and into or across this, dirt is hauled by carts, scrapers, or by sluicing. No core wall is built. This type of dam is seldom over thirty feet high (there is one at Waialua 60 feet high), and costs from $1,500 to $15,000. Dams of a greater height generally have a concrete core wall extending down from the original surface of the ground for from ten to forty feet, into bed rock; a wooden core wall imbedded in the concrete and extending down from the original surface of the ground for from ten to forty feet, into bed rock; a wooden core wall imbedded in the concrete and extending to the top of the dam helps to hold the water from soaking through the dam until the earth fill has had time to settle and harden.

The Wahiawa Dam.—The great Wahiawa dam, furnishing water to the Waialua plantation, on Oahu, is of the latter type of construction, but is unique in that it has a stone backing, on the down stream side of the dam, containing 26,000 cubic yards. This dam is 400 feet long, 100 feet high, 420 feet thick at the bottom and creates a reservoir with a capacity of 2,500,000,000 gallons, the largest in the islands. The earth dam of the largest capacity in the islands is at Koloa, Kauai, where a long dam only eighteen feet high encloses an old swamp, giving a storage capacity of 1,500,000,000 gallons.

Number and Capacity of Storage Reservoirs.—The following are the number and capacity of the storage reservoirs on the several plantations, so far as statistics have been obtained:

Plantations.	No. of Reservoirs.	Capacity in Gallons.
Maui—		
Maui Agricultural Co.	25	150,000,000
Hawaiian Commercial Company	18	730,000,000
Kihei	5	50,000,000
Pioneer	14	75,000,000
Oahu		
Honolulu	20	247,000,000
Oahu	36	300,000,000
Ewa	10	64,000,000
Waianae	1	200,000,000
Kahuku	4	75,000,000
Waialua	15	2,750,000,000
Kauai		
Koloa	7	1,565,000,000
McBryde	35	1,220,000,000
Hawaiian Sugar Co.	5	108,000,000
Makee Sugar Co.	..	200,000,000
Kilauea	5	.....
Hawaii—		
Kohala	7	30,000,000

All of the other irrigating plantations have storage reservoirs, but upon a smaller scale than those above enumerated.

(To be continued.)

INSECT INVESTIGATIONS IN MEXICO.

By Albert Koebele, *Consulting Entomologist.*

INTRODUCTION.

On my former visits to Mexico, I have never had an opportunity of making a systematic study of the insects affecting sugar-cane in that country, so during my recent stay there, I thought it advisable to investigate these. Even now, what we have learned can only be considered as a preliminary study. If we were to consider the numerous beetles, found on and in connection with the sugar-cane, the flies, the moths, the grass hoppers, which at times become very numerous, and finally the great number of species of leaf hoppers, the list would run up into the thousands.

In a casual inspection of the cane fields one would hardly suspect any serious enemy to be present. Those engaged in cane culture have often remarked to me: "We have no insects on sugar-

cane." Yet the mothborer (*Diatraea saccharalis*) is not only distributed over Mexico, but in many other localities and either it or an allied species is nearly of world-wide distribution in cane-growing countries. Should these insects ever turn up in the Hawaiian Islands, and continue their work undisturbed by any natural enemies, I should not hesitate in saying that fifty per cent. of the plants would be destroyed.

As we know that fully half the eggs laid by this moth are destroyed by parasites in Mexico, while probably many of the caterpillars are also destroyed by other parasites and various other enemies, the danger is but slight. The conditions that exist in Mexico could be established here, in fact a large improvement could be made on these conditions, and this in a short time after the moth's first appearance. That this mothborer will one day be found in the islands is not at all improbable in my opinion. Though it has been already credited as a member of our Fauna by Dyar and others, no specimen, so far, has ever been found in the islands, and these entomologists are, happily, in error on this point.

The large Jassid leaf-hopper, which I call the Mexican sugar-cane hopper, is a comparatively rare insect in its native home. Probably it is found much further south and also in the West Indies. Unquestionably it would become a great pest if accidentally brought into the islands without its parasites. Now that we are familiar with its many enemies, it is no longer to be feared, for its parasites with proper treatment would easily stand the short journey to the islands, or a much longer one for that matter. Below I have given an account of the more important insects found on sugar cane in Mexico. None of these are at present known in our cane fields; and should they be found, my investigations would enable us to prevent a reoccurrence of the loss experienced after the introduction of our leaf-hopper.

THE MOTH-BORER OF THE SUGAR CANE.

This is certainly the most injurious insect to the sugar cane in Mexico. It was noted some eighty years ago as a great pest on this plant in the West Indies, and since then it has been reported from various other localities, while in others including the East Indies a very similar species is likewise injurious. In the United States it is known as a pest on sugar-cane, sorghum, and corn, while it is likewise known to attack the "Gama grass" (*Tripascum dactyloides*).

In "Insect Life" (Vol. IV. pp. 95-103) Dr. Howard has given an exhaustive account of its life-history, distribution, the depredation caused by its caterpillar, and references to various publications on the insect, but in the articles that I have seen there is no mention of its parasites. More recently, however, the presence of egg-parasites has been noted in the West Indies. These

parasites have been referred to a well-known and widely distributed species the *Trichogramma pretiosa* of Riley.

In March I visited some cane-fields near Hermosillo in Sonora. At that time it was very dry and no sugar cane was growing in these fields. The land had just been plowed and the stools were lying about, more or less dried up. In these numerous larvae could be found, in fact, some of the stools were so badly mined and eaten out by them that few healthy plants could have been produced. The seed cane had been laid on the ground to a depth of some three feet, and covered by several feet of old cane leaves. Here the larvae were more numrous than in the old stools.

On every opportunity I examined the white variety of cane, sold for eating, at Nogales; and at Hermosillo a large quantity of a striped variety was shown me in an out-house. In none of these could I detect any eggs of leaf-hoppers, the moth-borer being the only insect found therein.

As a remedy in Mexico plowing up and burning the stools is performed annually. Flooding the fields after cutting, as is done in Morelos and Vera Cruz also destroys many larvae. I had ample proof of this in my observations in a very wet field near Orizaba.

On my first visit to a cane field in the State of Morelos I was able to note other interesting facts. Here I found a fresh batch of eggs of the moth-borer, and on the top of this a black Chalcid parasite was resting and laying its eggs in those of the moth. This parasite and the batch of eggs were placed in a glass vial, and during the following day it was again noticed ovipositing in the moth's eggs, but was dead on the morning of the third day. The vial and its contents were taken to Mexico City, where the temperature was rather low, and later to California, where after fifty days nine parasites emerged. Most of the other eggs had produced young larvae some time previously. This parasite does splendid work, fully fifty per cent.—if not more—of the eggs of the moth-borer are destroyed by it. It is equally numerous in the State of Vera Cruz, where a second and much smaller parasite was bred, two or three issuing from a single egg of the moth.

A mature caterpillar, collected in the State of Vera Cruz, kept in a box, where it had spun up in the top of a piece of cane, produced the larva of a parasite fly (*Tachina*). This larva pupated, but the mature insect was not bred.

NOCTUID LARVAE IN CANE TOPS.

At all the places visited, the caterpillar of a Noctuid moth, probably an *Agrotis* was found on the cane. When young the caterpillars often occur in numbers together, but when large or full-grown generally singly, feeding upon the tender leaves of the cane-tops. During the time of my visit no serious injury was done by these, but if numerous their work would be very harmful. I did not breed the moth of these caterpillars.

The small eggs are laid in clusters anywhere on the upper leaves, and from these eggs a very minute Chalcid parasite was bred. On a nearly full-grown caterpillar I found the egg of another parasite. No doubt this species will be found to have a large number of parasitic as well as predaceous enemies.

Of other caterpillars found feeding on cane, a few may be mentioned here. In a small space, the work of a large green Bombycid larva a species of *Automeris* was apparent, a colony of this species having, no doubt, been present. These caterpillars are omnivorous and may be found on many plants and trees.

A small mouse-colored, hairy caterpillar, bearing four prominent white tufts, and belonging to the genus *Halisidota* was present, but of no importance as a sugar cane pest.

Not far from an alligator pear tree, on which the larvae may have fed, and then wandered off to pupate, cocoons of a small Bombycid moth were found in the cane, but only in one locality. From these cocoons a large Chalcid parasite emerged. Eggs of a small Bombycid moth, producing small, pale, slender and hairy larvae, were also observed.

An egg-mass, not unlike that of the moth-borer, but containing many more eggs of far smaller size, was found on the under side of a cane leaf in the State of Morelos. This may have belonged to a Tortricid moth, the larvae of which were observed in the same field of young cane.

LEAF-HOPPERS.

The Large Mexican Sugar-cane Leaf-hopper.—This is a large Jassid leaf-hopper, about three-quarters of an inch in length, the scientific name of which is *Cyrtodisca major.* Prof. Herrera informed me that the insect had been received from Jonacatepec, Morelos, where it is a plague to sugar cane in the State and presented me with specimens. Having traveled over a large part of the same State, and to within about seventeen miles of Jonacatepec, it is singular that I did not meet with a single specimen of this gigantic leaf-hopper there, nor yet again in Vera Cruz. The insect has been described in an American paper as a new pest on sugar cane in Mexico, but I anticipate no serious trouble from this insect, as an enemy of cane. While working on the Lantana insects in 1902, colonies of leaf-hoppers were met with living on that plant gregariously and these belong partly to the above named species and partly to others of the genus. Prof. Herrera showed me examples of a related species that lives on the twigs of orange trees.

The Mexican Sugar Cane Hopper.—This *Cyrtodisca* is not unlike the preceding, but has the head more pointed and is only about half an inch in length. It is of a dull blackish color, more handsomely marked in the State of Vera Cruz, having a light yellow dorsal line on the head and orange on the pronotum. It is

equally distributed in all the places I visited, breeding throughout the year. Yet owing to the very efficient parasites that attack it, destroying a large percentage of its eggs, it is not very numerous. I have not seen more than eight or ten mature insects in one cane-top, which is the part they mostly affect. The eggs that presumably belong to this insect (for I had no opportunity to rear it) are laid in the midribs of the leaf, usually near the base, yet sometimes far forwards, rarely in the leaf-sheath. I did not observe that they were ever laid in the cane stem. A crescentic slit is made either on the lower or upper surface and the eggs are placed together beneath the epidermis, nearly always on the top of the midrib. The young nymph on hatching is pale, probably after the first moult it becomes dark brown, except for the pale abdomen. The larger nymphs are again pale yellow with transverse narrow black bands across the wing pads, while the legs are also black.

Many nymphal skins are found on the under side of the older leaves, but as the nymphs become larger they seek the more tender leaves of the top. The mature insects are very active, the slightest jar on the plants will rouse them from their hiding place, ready for their jump. They usually fly off for some distance and settle again on another plant or even on the ground. Prof. Herrera was not acquainted with this insect.

As is the case in Australia and Fiji with our cane leaf-hopper, the eggs of the Mexican hopper are largely destroyed by fungous diseases. At least two species of Mymarid parasites were bred from its eggs and appear to be very numerous, as also are several species of minute Chalcid parasites. The parasites bred from collected eggs were much more numerous than the young hoppers. As the season was late, these conditions may be different about midsummer. These parasites could easily be transferred, for during the cool winter months the Mymarids issued from eggs six weeks after these had been collected. A small yellow Chalcid issued from eggs collected on Dec. 14, 1907, up to Feb. 16, 1908, when the material was kept in a room with a temperature of about fifty degrees at night and seventy at midday. These minute insects lived for eight or ten days, when supplied with water, which they drink eagerly. For their preservation alive, it is obviously necessary to keep the material in a proper state of moisture.

No trace of Dryinid parasites could be detected on this insect, yet it is just possible that such may be found at another season. Parasitic flies of the genus *Pipunculus* were noticed in the cane-fields, but none were bred.

Possibly a valuable agent in reducing the numbers of this and other leaf-hoppers on sugar-cane, as well as the Noctuid caterpillars that I have already referred to, is a medium-sized Reduviid bug. It lives in the tops of the cane plants and its nymphs are probably more valuable than the adults, as they wander less. An egg mass of this species produced young, that lived in a glass tube, without food, for a long time; one, indeed, survived for four

weeks, having probably sustained itself by devouring its companions.

An ear-wig (*Sphingolabis taeniata*) is also found commonly in the cane tops, and no doubt feeds both on the leaf-hoppers and the Noctuid caterpillars.

Several other species of Jassid leaf-hoppers were found living on sugar cane. In fields containing weeds and grass they were especially numerous, being most abundant along the borders of the field and in places covered with "Para" grass. This grass is alive with masses of leaf-hoppers, both Fulgorid and Jassid. In the center of clean fields and away from grass these leaf-hoppers, excepting the one I have specially termed the Mexican cane-hopper, become very rare, yet the fact that they breed on sugar cane is evident, since their nymphs were found on this plant in the months of November and December.

The Chinch Bug (*Blissus leucopterus* Say) is also found on cane, both in Morelos and Vera Cruz, and I also collected it in the City of Mexico.

Fulgorid Leaf-hoppers.—A large number of species of leaf-hoppers related to our cane leaf-hopper could certainly be found in Mexico on sugar cane, in fact I have secured quite a number of different forms. Yet, only in the State of Morelos did I find three egg-masses, which, I believe, belong to a Fulgorid. They were irregularly inserted in and near the midrib, one batch on the under side and the others on top of the leaves. Some of these eggs were covered over with a white excretion as usual, but others were entirely exposed, giving easy access to parasites. From these eggs collected November 27th, four Mymarid parasites issued on December the 10th.

OTHER INSECTS ON CANE.

One species of a Tingid bug was found breeding on the under side of cane leaves in the State of Vera Cruz, and it was evident that in one part of the field a number of colonies had been present, but at the time I found them few specimens remained.

Aphidae or Plant-lice appear to be common during the season on the cane, but during my visit were rarely met with. In spite of this their natural enemies were still in large numbers, both Syrphidae, Chrysopidae and Coccinellidae. Of the lady bugs *Megilla maculata Say* was most numerous in Morelos, *M. vittigera* Mann. was found near Orizaba, *Hippodamia convergens* Guer. numerous everywhere, as also was *Coccinella sanguinea* Linn. Two species of *Scymnus* were also present, and were probably feeding on plant-lice.

A species of fly of small size was found, the larva of which burrows in the midribs of the cane leaves. The mine made by this slender larva often extends throughout the whole length of the leaf, in other cases it extends ten or twelve inches, the larva having turned round and formed two or three mines side by side.

When full-grown, it eats out a hole almost to the surface of the midrib, and pupates there. Finally the puparium is pushed through the thin covering above it and the fly issues therefrom. Although common, I did not breed many of this fly and no parasites were observed, though, I doubt not, such are present.

Another fly breeds commonly in the decaying parts of the sugar cane, where these have been attacked by the caterpillar of the moth-borer. It is very numerous, yet cannot be said of itself to do any real injury to the cane.

THE WAY JAVA CAME BY HER PRESENT EXCELLENT SUGAR CANE.

In the year 1892 a mysterious, up to that time still unheard of, disease befell the sugar cane plantations in the most western part of Java and gradually spread in an eastern direction, crawling along every year till at the end of 1892 all the sugar growing districts of the island were infested with it. The symptoms of the disease were chiefly a stoppage of the growth after a few months' vegetation and a considerable development of secondary stalks and aerial roots. Those secondary stalks were in their turn also attacked by the disease and remained short too, so that the whole stool instead of representing the usual aspect of a stately group of long stalks, crowned with green tufts of leaves, resembled the crumpled bunches of the citronella grass, after the Javanese name of which, "sereh," the disease was called sereh-disease. Of the symptoms mentioned, of course, that respecting the stoppage of the growth is the most serious one and in fact it decreased the yield of a diseased field in such a way as to render it practically valueless. It is a happy circumstance that the disease first commenced in one part and only very slowly proceeded eastward and thus allowed the planters to take their measures. If it had struck the whole of the island at the same time, very likely it would have destroyed our sugar cultivation right out, the more so, as at the same time a serious crisis in sugar prices prevailed which was apt to endanger the existence of many sugar estates even without the aid of the disease. Now it fortunately took 10 years before the sereh disease had spread throughout the whole island and the planters made a happy use of that respite to bethink themselves of remedies to combat it.

While the western part of the land was infested the middle and eastern parts still were free and could spare a continuous stream of sound cane tops, which were used for replanting the attacked cane fields in the western parts; but as the disease slowly but uninterruptedly spread eastward the available amount of sound tops decreased yearly while the area, wanting them, increased accordingly so that everybody could prophesy that this way of combating

the dreaded disease was only a palliative and no remedy. In that time the Java planters sought the aid of science and established three experimental stations in different parts of the island with the chief object of suggesting means to save their industry from the threatening ruin. The scientists attached to the stations, chiefly botanists of already fixed European renown, started work at once and besides investigating into the real cause of the disease, looked out for practical ways to stamp it out or to avoid it. A great deal of cane varieties from every cane growing country were brought over to Java, propagated and planted in the different estates and in fact among the hundred and odd of those varieties a few proved in the first years after their introduction to be of great value; they were immune against sereh and produced yields which were by no means inferior to those obtained with the black Java or Cheribon cane. At the same time the planters wanted to continue the way of planting every year afresh with sound tops from parts of the land, where the sereh had not yet appeared, as they did not like to leave the variety which had given them every satisfaction up to now and feared the new varieties could some day or other degenerate and become in their turn victims of the same or another disease. As we saw before, the sugar growing parts of the land became gradually infested, so that it soon became impossible to procure sufficient seed for the estates from the tops of still existing sound cane fields. Therefore, the sugar estates selected in the mountains and similar remote spots, where no sugar industry existed, fields where they planted cane for seed only. Sound tops were carefully selected, planted with much care in a mountainous region, far from every infection by other cane and raised canes, which were cut six or seven months after planting and used for seed in the plains for the planting of cane fields. As it soon appeared that ratoons became unfailingly infected with sereh and did not yield even moderately good crops, where the plant cane had produced a good one, the planters were compelled to keep off from growing ratoons and since the last 15 years no ratoons are kept in Java and all of the sugar cane is planted every year again. The introduction of the varieties from other countries and the system of nurseries in remote parts together coöperated in expelling the disease, but at what cost!

The new varieties gradually fell off in quality and could not be relied upon, which always gave a feeling of uneasiness for the future, while the expense of the nurseries and the transport of tops from them were too heavy to be continued. In many cases the expenses for the tops even amounted to one-fifth of the whole cost price of the sugar and this item became so heavy that it swallowed all of the profit, while at the same time the danger remained that also the mountainous parts one day or other would be attacked and excluded from the raising of the seed. In the meantime, however, the scientists had continued their researches and raised cane from seeds; first in a haphazard way, but after-

wards on a scientific and systematic footing. At the outset some arrows were cut, spread out on carefully prepared soil and the resulting tiny cane plants were nursed and planted out in the field. Every plant was analysed, weighed, inspected and observed and the inferior plants steadily removed so as to keep only the selected good ones. This selection was so rigid that from the thousands and thousands of plants only some two or three came into use. This terrible waste of time and work induced some investigators, especially Messrs. Moquette, Kobus and Bouricious to select canes of varieties which promised much in some direction or other and to cross-fertilize their flowers, so that not as formerly, fertilization with some unknown pollen was secured but the fertilization was effected with carefully selected pollen of especially chosen fathers. The results were brilliant and Java came into possession of families of sugar cane, which surpass in every point the old canes of yore. Now there is such a variety of good and rich cane that every estate owner can choose the varieties which best suit the quality of his land, or his climate and even suit the time when he wants to harvest them. He can choose early ripening varieties for the beginning of his crop and late ripening ones for the end and so dispose during the whole course of his grinding time of green, fresh and sound cane at its highest point of sugar content and vigor. Not contented with the results already obtained Mr. Kobus is steadily busy breeding new varieties in order to replace the existing ones if perchance these might in their turn degenerate or become attacked by some new infectious or other disease.

This brilliant success accounts a great deal for the excellent Java returns of the last few years and we can safely say that the sereh disease has not only totally disappeared but has had the unexpected advantage of providing Java with a supply of canes much better and more resistant against drought or wet weather, against insects and disease, than has any other country and moreover has the experience in how to create new varieties if the existing ones fail. It is obvious that only tropical countries, where the cane attains its full maturity and flowers every year, can obtain the same results and that for non-tropical countries the raising of new varieties will meet with much more difficulty.—H. C. Prinsen Geerligs in La. Planter.

COLONIAL TARIFFS.

The United States cannot be said to have any definite colonial tariff system, for there is no uniformity in the tariffs of its several insular and other outlying possessions. It is true, however, that the territories of Hawaii and Alaska, and Porto Rico, with its quasi territorial government, are the subject of uniform tariff treatment. There is complete free trade between each and con-

tinental United States and, of course, between each other, and imports into each from foreign countries pay the duties of the Dingley tariff, excepting as reduced by the several commercial agreements concluded by this Government under section 3 of that law, and by the reciprocity treaty with Cuba. To this extent, therefore, we have a colonial tariff system, but, on the other hand, the Philippines, Guam, Tutuila and the Panama Canal Zone have tariffs of their own and do not enjoy free trade relations with the United States. This diversity of treatment creates problems of much importance, as we shall see.

HAWAII.

Until annexed by the United States, Hawaii had its own customs tariff on imports of foreign goods. Theoretically this applied to American goods; but, as a matter of fact, practically everything imported from the United States had enjoyed for more than twenty years exemption from duty under the provisions of the reciprocity treaty. While the islands were acquired under a joint resolution of Congress, approved July 7, 1898, their present tariff status is based upon an "Act to provide a Government for the Territory of Hawaii," approved April 30, 1900, which went into effect on June 14, 1900. This act established a territorial government; repealed the former import duties and customs laws; applied the Constitution and all laws, of the United States not locally inapplicable, and made the territory a customs district of the United States. Since then Hawaii has had precisely the same tariff status as any State or contiguous territory of the United States.

PORTO RICO.

The acquisition of Porto Rico and the Philippines as the direct result of the war with Spain presented to the United States its first colonial tariff problems for the case of Hawaii hardly caused any concern, since there had been virtual free trade between the Hawaiian Islands and the United States for so many years. During the first three years of American ownership of Porto Rico a tariff barrier between the island and this country was permitted to exist, although the duties collected on imports of Porto Rican products were reserved for the benefit of the island and expended there. This arrangement, however, was unpopular and unsatisfactory. Since the proclamation of July 25, 1901, Porto Rico has enjoyed complete free trade with continental United States, and it shares in the tariff privileges secured by this government in various foreign countries through the medium of reciprocity arrangements. Imports from foreign countries into Porto Rico are, of course, subject to the payment of the duties of the Dingley tariff, with the modification made by the Cuban reciprocity treaty and the commercial agreements under Section 3 of Tariff Act. It

will thus be seen that Porto Rico is on perfect equality with Arizona, New Mexico and Hawaii as respects tariff treatment, although the same cannot be said of its government, which is in a class by itself.

THE PHILIPPINES.

While the tariff relations of Porto Rico have been settled satisfactorily, those of the Philippines remain as a knotty problem, to solve which several fruitless attempts have been made in Congress in the last few years. There is a marked contrast in the tariff relations between the United States and Porto Rico or Hawaii, on the one hand, and between the United States and the Philippines on the other hand. In the case of the former we have seen that there is absolute free trade; in the latter there are tariff barriers for the trade both ways.

From the outset the Philippine Islands have had a customs tariff of their own, formulated by the Philippine Commission. The rates of this tariff are applied impartially to imports from the United States and foreign countries, there being no differential treatment whatsoever in favor of our own commerce in this respect. A different policy might easily have been pursued without giving justification for complaint on the part of any foreign government. There might be, for example, a pro-American tariff of reduced duties exclusively applicable to imports from the United States, or such goods might be preferentially admitted free of duties. It is important to bear in mind, however, that during the ten-year period following the date of the ratification of the Treaty of Paris, which provides for the admission of Spanish ships and merchandise to the ports of the Philippine Islands under the same conditions as ships and merchandise of the United States—that is, until April 11, 1909, any tariff advantages enjoyed by American goods would necessarily be extended to like goods of Spanish origin. Perhaps this feature of the law will explain the non-discriminatory character of the Philippine import tariff.

The present customs tariff was established by "an act to revise and amend the tariff laws of the Philippine Islands and for other purposes," approved March 3, 1905. The operation of the previous tariff, which had been in use since November 15, 1901, having shown the need of revision, this was undertaken in the year 1904. In preparing the present schedules an effort to obtain the best technical advice and information was made. A committee of customs experts and business men of the Philippines sat in Manila and took the testimony of those interested as to desirable changes in the former law. The report of this committee, after approval by the Philippine Commission, was transmitted to the Secretary of War, who, through the Bureau of Insular Affairs, gave it wide publicity in the United States and invited suggestions and recommendations. The few suggestions submitted in response to the invitation were duly considered and such changes in the schedules

as seemed desirable were made with the approval of the Philippine Commission, and then the proposed tariff was submitted to the Chairman of the Ways and Means Committee of the House of Representatives, who introduced it as a bill. The Committee on Ways and Means held hearings on the proposed revision, and, after a few amendments, the tariff was passed and approved by the President on March 3, 1905.

The Philippine tariff has proved reasonably satisfactory and has been the subject of but little serious criticism. On the other hand, the tariff treatment in the United States of importations from the Philippines has been the subject of considerable diversity of opinion and controversy. Efforts, strongly supported by the War Department, have been made for the last three or four years to induce Congress to grant more favorable treatment to the Philippine products. At the present time, in accordance with Section 2 of "an Act Temporarily to provide revenue for the Philippine Islands, and for other purposes," approved March 8, 1902, all articles the growth and product of the Philippine Archipelago coming into the United States from there pay only seventy-five (75) per centum of the regular rates of duty of the Dingley tariff, while all other importations from the same source pay the full duties. It is further provided by the same act that the rates of duty collected on Philippine products shall be less any export duties collected thereon in the islands. Analogously to the former arrangement affecting Porto Rico, all duties collected in this country on importations from the Philippine Archipelago are not covered into the general fund of the United States, but are held as a separate fund and paid into the treasury of the Philippine Islands, to be used and expended for the government and benefit of the Islands.

GUAM.

The Island of Guam, one of the Ladrone or Mariana Islands, in the North Pacific Ocean, was acquired by the United States under the Treaty of Paris. It is under the control of the Navy Department, the governor being a commander in the United States Navy. Like the Philippines, Guam has a special customs tariff of its own. This tariff was promulgated by President McKinley in an order dated February 1, 1900, and it is administered exclusively by the Navy Department.

TUTUILA.

In 1899, the United States, Great Britain and Germany executed a treaty whereby the two last named powers renounced in favor of the United States all their rights and claims over and in respect to the Island of Tutuila and all other islands of the Samoan group, east of longitude 171 degrees west of Greenwich. The United States took possession of the portion of the Samoan

Islands allotted to it, and the same was assigned by President McKinley to the Navy Department for a naval station, by an order dated February 19, 1900. That department has since continued to exercise control over these American possessions. The Island of Tutuila, of which Pago Pago is the port of entry, is the only one of the group with which we are concerned for tariff purposes.

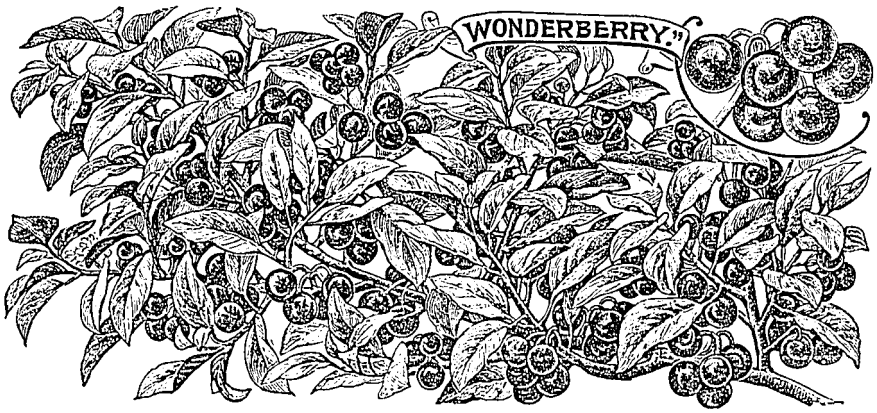
The first tariff of Tutuila was contained in "Temporary Customs Regulations," promulgated by the American commandant on April 24, 1900. Besides a few specific duties, the general rate was 2 per cent. *ad valorem* on goods not specified, imported from any source.

PANAMA CANAL ZONE.

The tariff situation of the Panama Canal Zone, which is virtually American territory, is *sui generis*. Control over this territory was acquired by the United States by the convention between the United States and the Republic of Panama for the construction of a ship canal to connect the waters of the Atlantic and Pacific oceans, signed at Washington on November 18, 1903.

At the present time the Canal Zone is treated as Panamanian territory in all cases excepting where importations are made into the zone for use in connection with the construction of the canal. Where this exception does not apply imports from the United States are treated the same as those from any other foreign country; they are subject to payment of the import duties of the customs tariffs of the Republic of Panama.

Imports into the United States from the Canal Zone are subject to payment of the regular duties of the Dingley tariff, as if imported from a foreign country. This status is established by an act of Congress, approved March 2, 1905.—*Dun's Review.*



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